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Antike Technik. Sechs Vorträge. H. DIELS. Teubner: Leipzig and Berlin, 1914. 140 pp., 50 figs., 9 pls.

H. Diels belongs to that sane and refreshing type of classical philologist that likes to cross the Chinese wall of the special field and by his broad outlook comes in contact with representatives of many other disciplines. In 1908 the edition of a new Greek work, ascribed to Melampus, and treating of divination from the throbbing or pricking of certain bodily organs (known to every one, for instance, from Shakespeare's Macbeth: "By the pricking of my thumbs, Something wicked this way comes") gave him occasion to study the same subject with the assistance of a staff of able collaborators, and to edit related books from Russian, Serbian, Bulgarian, Rumanian, Arabic, Hebrew, Turkish, Indian, German, English, and French,—a contribution to folklore of the first order.[1] His fruitful interest in the history of natural sciences and medicine is well known, and the attempt of such a high-standing authority to acquaint a larger public with some of the chief results of his science in concise and elegant form must be received with great satisfaction. He was mainly actuated by the desire to demonstrate by way of selected examples that classical antiquity, even in its technical achievements, is much more intimately associated with the modern world than the intervening middle ages, and that innumerable threads visible and unseen link these two worlds together. The struggle of engineering and natural science against humanism in the last century was based on a deplorable mutual ignorance and semi-culture of the two conflicting parties: the humanists, in the grip of a nebulous idealism, were unfamiliar with the material civilization of the ancients and unable to grasp its connection with our modern life, while the adversaries flatly rejected any reminiscence of our indebtedness to the ancients. This state of affairs has changed, for the classical philologists, though they may still belong to the best-hated species of mankind, a veritable *odium generis humani,* have now deeply penetrated into the realities of antique culture and pay as much attention to them as to its canon of beautiful forms and its ideal thoughts. The author's six lectures deal with science and technics among the Greeks; antique doors and locks; steam-engine, automaton, and taxameter; ancient telegraphy; ancient artillery; and ancient chemistry. Diels has been the first to reconstruct correctly the Homeric system of closing a door by means of lock and key, and his study of this subject is of great ethnological interest, as, for instance, analogies to the so-called *balanos* lock, which is found in Egypt, as early as the time of Ramses II (1292–25), still exist in China and Tibet. It might be worth the trouble to pursue this object in its distribution all over Asia. Our taxameter is modeled after the principle of Heron's hodometer, and certain modern automatic devices may well be traceable to ideas first conceived by Greek mechanicians. Carrier-pigeons were known in Hellas during the fifth century B.C., and were utilized by the Romans in beleaguered cities and for the transmission of sport news after races. As justly remarked by Diels, this practice was derived from the Orient. A Chinese author of the ninth century, it may incidentally be added here, reports that the Persians kept pigeons on board their ships and sent them back with letters to their homes over distances of several hundred miles (*Yu yang tsa tsu*, ch. 16, p. 6). Noah's dove, however, was not a carrier-pigeon, as asserted by Diels, but represents a distinct affair: it belongs to the category of land-spying birds dispatched by navigators in search of land, frequently mentioned in India and Babylonia, also by Pliny (VI, 22; see my notes in *T'oung Pao*, 1914, p. 11).

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[1] Beiträge zur Zuckungsliteratur des Okzidents und Orients, *Abhandlungen der preussischen Akademie,* two parts, 1908–09.

The chapter on the telegraphy of the ancients is full of interest. Long-distance communication was well developed by fire signals, a water telegraph, and torch signals expressive of the letters of the alphabet. In Aeschylus' *Agamemnon* we have the earliest example of a rapid transmission of a message from Asia to Greece: the conquest of Troy is signaled by huge bonfires from Mount Ida in Asia Minor by way of the island of Lemnos to Mount Athos, then flashed southward over Euboea into Boeotia and Mount Kithaerum, thence across the Isthmus to Epidaurus and ultimately to the castle of Mycenae. From Herodotus' statement that Mardonius after the battle of Salamis expected to send to Xerxes the news of the capture of Athens by fire-signals along the Aegaean islands to Asia, Diels rightly infers that such like institutions existed in Asia; in fact, they are alluded to in Babylonian texts. The most ingenious instrument of the ancients was the signal telegraph described and improved by the historian Polybius. Each station was formed by two battlemented turrets, each wall having five crenelles or embrasures, two feet distant from one another, in which torches could be placed. The system was based on a chiffre according to which the twenty-four letters of the Greek alphabet were distributed over five tables; in each table the letters were numbered in succession. Two operations were thus required for telegraphing a single letter, one turret serving to indicate the number of the table, the other, the number of the letter in question within this table. The letter K, for instance, was listed in the second table; accordingly, two torches were shown in the embrasures of the first bastion. K being the fifth letter of the second table, five torches were placed in the second bastion. It has been calculated that a dispatch of only three words, like "hundred Kretans deserted" would require a hundred and seventy-three torch-signals, and that the transmission could be accomplished within a half hour. It is obvious that this system contains the germ idea of electric telegraphy. It had no practical success, however, which Diels attributes to various causes, as the scanty range in the radiation of the torches, the great number of stations required, the complexity and costliness of the enterprise. It seems to me that the main cause for its failure must rather be sought for in the republican institutions of the Greeks, which lacked a centralized will-power and the strong hand of a ruler interested in the maintenance of such a service; for in all Oriental empires postal and intelligence organization was far superior to that of Greece. In ancient China, optical telegraphy by fire-signals was at a high stage of development as early as the third century B.C. Many of these ancient watch-towers have survived, particularly in Turkistan. They were erected in defence of the empire, the news of an invasion of nomadic tribes being at once signaled to the capital, two, three, or four firebrands in succession indicating the strength of the hostile forces. At the same time, and similarly as in the Persian empire, a staff of rapid couriers changing horses every fifth kilimeter or so was maintained. Marco Polo (chap. XXVI) and other mediaeval travelers have left us vivid descriptions of this magnificent postal system.

Artillery (by an irony of fate this word is derived from *artes*, "arts") was well known to the ancients, and from the descriptions of the historians and the writers on military matters the various types of antique cannon have been reconstructed and examined as to their range and effect. Remains of them have not survived, as they were chiefly constructed from wood; but missiles from sandstone, three to ten pounds in weight, and arrow-points have been unearthed in Spain on the site of the ancient Numantia, and are supposed to have been hurled into the city on the occasion of its gallant defense against Scipio the Younger in 133 B.C. For the first time we hear of the employment of artillery around 400 B.C. in Syracuse under Dionysus the Elder (I hardly think we can say with Diels that it was "invented" in that year; dates for inventions are usually fallacious). According to a theory of Diels, the ancient cannon was developed from the bow by way of the crossbow. With all their ingenuity the ancients have nothing to oppose to the Chinese repeating crossbow with a magazine holding up to ten darts which may be shot consecutively and rapidly, the darts sinking through their own weight,—mentioned in the Annals as early as 211 B.C.,—the prototype of our magazine rifle. Diels frankly admits that the modern development of weapons is not directly connected with Hellenic tradition; but "an imperceptible transition is visible in the so-called Greek fire derived from Greek tradition in its relation to modern fire-weapons." Indeed, he heralds the Greek fire as the precursor of gunpowder, without any regard to the well-founded claim of the Chinese to this invention and the admission of the Arabs that it was received by them from the Chinese. It is unproved that the Greek fire, first mentioned by Marcus Graecus in his *Liber ignium* toward 1250, has any connection with ancient Greece; moreover, it was a combustible or incendiary, but not an explosive like gunpowder. In China we can trace a rational development of gunpowder from the humble firecracker (known in the sixth century of our era), which was originally employed in religious ceremonies, to the launching of fiery projectiles in warfare as early as the twelfth century and the full development of fire-weapons under the Mongols in the thirteenth and fourteenth centuries. In Java, Sumatra, and the Philippines fire-arms were known and used prior to the arrival of Europeans. It is therefore out of place to say that as early as the beginning of the fifteenth century cannon advanced from Europe to China (p. 101). An Arabic treatise on gunpowder written in 1249 and preserved in the Library of the Escurial, styles saltpetre "Chinese snow" (*thelg-as-Sīn*) and the rocket "Chinese arrow" (*sahm khatāī*); saltpetre was first exported by the Arabs from China, where it occurs as a natural efflorescence of the soil in Szechuan, Shansi, and Shantung. Arabic writers mention fire-arms as far back as 1312, and in 1323 they were used at the siege of Baza. It is certainly due to Moorish influence when they make their first appearance in Spain. In the opinion of Diels, "this progress (?) is due neither to the Arabs whose claims are certainly unjustifiable, nor to the Chinese, but to the Germans," because the Germans were regarded by Byzantinians and Italians as the inventors of this new "barbaric" technique, and because in the fourteenth and fifteenth centuries the Germans exclusively possessed a literature on artillery, and German gun-smiths were everywhere in demand. All this is imaginary or inconclusive. The Germans may have had their share in the further development of fire-arms, but crediting them with their "invention" and even with the invention of gunpowder is a misstatement of facts.

In his discourse on chemistry Diels rejects the current etymology of this term from the Egyptian. He adopts the forms *chymes* and *chymeia* as a basis and derives them from Greek *χύμα* (metal-cast), metal-casting being in the center of antique chemical technology. A very interesting extract is given from the *Papyrus Holmiensis* in Upsala concerning Egypto-Hellenistic alchemy. At the end the author comes back to his former theory that alcohol should have been known to the Greeks, and was to a larger extent manufactured toward the close of the thirteenth century after a recipe of probably Greek origin. The article of J. Ruska in which this opinion is convincingly refuted should at least have been mentioned; also it would be interesting to know what Diels' attitude toward his opponent's arguments is.[1] The reviewer sides with Ruska and E. v. Lippmann in the opinion that the isolation of alcohol is not due to the Greeks or the Arabs, but a discovery made in Europe toward the close of the middle ages. It is justly emphasized by Ruska that with all respect for Alexandrine and Arabic science we are compelled to admit that the age of discoveries begins in the West at an earlier date than is usually assumed, and that we are not justified in contesting to the closing middle ages the discoveries then mentioned for the first time, although frequently under a false flag. The middle ages were not quite so dark and backward as believed by Diels and many others. Though we respectfully dissent from the author as to his result in the alcohol problem, we gladly concede that his study contains a great amount of new and useful information, and in the same manner as the present volume, is an important contribution to the history of science.

B. LAUFER

ASIA

Indian Shipping. A History of the Sea-Borne Trade and Maritime Activity of the Indians from the Earliest Times. RADHAKUMUD MOOKERJI. Longmans, Green and Co: London and New York, 1912. XXVIII, 283 pp.

Books move slowly these days. A copy of Professor Mookerji's work reached me only in August, 1916. The history of navigation and shipping is a subject of primary importance for the study of early international relations: especially in the sphere of the Indian Ocean, tribal

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[1] Compare H. Diels, "Entdeckung des Alkohols," *Abhandlungen der preussischen Akademie*, 1913, no. 3; J. Ruska, "Ein neuer Beitrag zur Geschichte des Alkohols," *Der Islam*, vol. IV, 1913, pp. 320–324, and "Alkohol and Al-kohl, zur Geschichte der Entdeckung und des Namens," *Aus der Natur*, vol. X, pp. 97–111.